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Utilization of Waste Flex in Concrete

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Abstract

This research includes the result of an experimental investigation about the disposal of waste flex in cement concrete without compromising its normal strength. Solid waste management is a very critical in the present context and also going to be very great issue in future. Flex is used for different kinds of hoarding boards for advertisement and many other purposes. As its uses is increasing rapidly day by day, its disposal is also becoming difficult as it is a kind of plastic and disposing of plastic is critical issue at the present context throughout the world because it causes different types of pollutions resulting to the different diseases among the human beings as well as other living creatures on earth. In this research work, waste flex is added in cement concrete mix by making very small pieces about some percentage of cement in the mix. This will minimize the problem of disposal of waste flex and is also somewhat reducing the cost of concrete by using waste materials. We have adopted three percentage of flex in concrete mix i.e. 0 .75%, 1% and 1.5 % by the weight of cement. The concrete mix adopted for the experiment is M-25. This report includes the comparative study of compressive strength of concrete cubes containing the waste flex with normal concrete of same design mix after curing the cubes for 7 and 28 days. It was found in experiment that the compressive strength is increased at addition of 1% of flex by the weight of cement in concrete and similar strength at other two percentage of flex compared to the compressive strength of normal concrete tested after curing of cubes respective number of number of days.

Keywords: *Bamboo Reinforced Concrete, Compressive Strength, Split Tensile Strength, Flexural Strength.*

1. INTRODUCTION

Solid waste management is a very critical in the present context and also going to be very great issue in future. Flex is used for altered kinds of hoarding boards for advertisement and many other purposes. As its uses is increasing rapidly day by day, its disposal is also becoming difficult as it is a kind of plastic and disposing of plastic is critical issue at the present context all over the world because it causes different types of pollutions resulting to the different diseases among the human beings as well as other living creatures on earth. The only disposal of plastic waste is either by incineration or by land filling but these processes have their significant impacts on the environment. As per Marrickville Council of Australia, as many as 100,000 whales, turtles and birds die have been reported to die every year, mainly because of plastic in their environment. Different research works are being carried out by different student, professionals and experts over the world to minimize bad impacts on the environment cause of plastic. Cement concrete is a mix of different kind of raw materials mainly binding material cement, aggregate (fine & coarse) and water. Cement concrete is used in almost all types structure and due this reason its demand is increasing day by day. The demand of concrete is very large but the resources are limited which leads to shortage and increment in price of raw materials for cement concrete. In this research work, waste flex is added in cement concrete mix by making very small pieces. Waste flex is added in the concrete in different doses i.e. 0.75%, 1% and 1.5 % by the weight of cement. This will minimize the problem of disposal of waste flex and is also somewhat reducing the cost of the concrete by using waste materials. In same time this will also reduce the environmental issues causing disposal of plastic waste.

Zainab *et al.* (2007) discussed that the compressive strength values of all waste plastic concrete mixtures tend to decrease below the values for the reference concrete mixtures with increasing the waste plastic ratio at all curing ages. This may be attributed to the decrease in the adhesive strength between the surface of the waste plastic and cement

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paste. A concrete mixture made of 20% waste plastic has the lowest flexural strength at 28 days curing age, viz. 30.5% below the value of the reference concrete mixture. At 28 days curing age, the lowest dry density (2223.7 kg/m3) exceeds the range of the dry density of structural light weight concrete.The fresh density values of waste plastic concrete mixtures tend to decrease by 5%, 7%, and 8.7% for Pl2, Pl3, and Pl4, respectively, below Pl1 but they are still averaged to the reference concrete mixture.

Kathe *et al.* had mention that in Concrete, Natural sand can be replaced with plastic waste by 10 to 20% to achieve green concrete. Sand can also be replaced up to 30% in the members of building which do not carry high load. Using plastic waste such as polyvinyl chloride (PVC), Polypropylene (PP), Polyethylene in concrete reduces the environmental issues and minimizes the difficulties of dumping the major plastic waste.

Ramadevi *et al.* (2012) discussed that the concrete with PET fibres reduced the weight of concrete and thus if mortar with plastic fibres can be made into light weight concrete based on unit weight. It was observed that the compressive strength increased up to 2% replacement of the fine aggregate with PET bottle fibres and it gradually decreased for 4% and 6% replacements. Hence replacement of fine aggregate with 2% replacement will be reasonable

Nibudey *et al.* (2013) studied flow properties of concrete after inclusion of fibres content. The density was also affected but made concrete slightly light weight. The maximum compressive and split tensile strength were at 1% of fiber content were 4.30%, 11.21% respectively over control concrete (0% fibres content). The significant improvements in strengths were observed with inclusion of plastic fibres in concrete. The optimum strength was observed at 1% of fiber content for both types of strengths, there after reductions in strength were observed.

Mathew *et al.* (2013) determined the suitability of PCA for structural concrete. A percentage replacement of 22% NCA with PCA was found to be of superior concrete compressive strength. With regard to its tensile behaviour the bonding strength of PCA with matrix needs more attention, since PCA concrete has shown a substantial reduction in split tensile strength and elastic modulus.

Ghernouti *et al.* analysed the effects of an incorporation of plastic waste on the physical and mechanical properties of the concrete. In their stydy the bulk density has decreased considerably for all doses of concrete with the content of replacement of sand by plastic waste that also becomes than lighter with 40% of plastic waste. Being given that the concrete must have good workability, fluidity is significantly improved by the presence of this waste. A reduction in the mechanical resistance according to the increase in percentage of plastic bag waste, which remains always close to the reference concrete, when we recorded a fall of compressive strength at 28 days about 10 and 24 % or the concrete's containing 10 and 20 % of waste respectively.

Lakshmi *et al.* (2013) tried to find the effective ways to reutilize the hard plastic waste particles as concrete aggregate. Analysis of the strength characteristics of concrete containing recycled waste plastic and fly ash gave the following results. It is identified that e-waste can be disposed by using them as construction materials. Since the e-waste is not suitable to replace fine aggregate it is used to replace the coarse aggregate. The compressive strength and split tensile strength of concrete containing e-plastic aggregate is retained more or less in comparison with controlled concrete specimens. However strength noticeably decreased when the e-plastic content was more than 20%. Addition of fly ash in the mix considerably improves strength index of control mix as well as e-waste concrete. The strength development of fly ash based e-plastic concrete in early days found to be less but 28 days compressive and split tensile strength has proven results in comparison with controlled concrete up to 25% e-plastic replacement. It has been concluded 20% of E-waste aggregate can be in corporate as coarse aggregate replacement in concrete without any long term detrimental effects and with acceptable strength development properties.

Gawatre *et al.* (2015) have done practical experiment on electronic waste and concrete. There study is carried out to find the effective and capable ways to utilization of the hard plastic waste particles as fine aggregate. It is also observed that the compressive strength of concrete is found to be optimum when fine aggregate is replaced by 7.5% with Electronic waste. Beyond it the compressive strength of concrete goes on decreasing. The compressive strength of concrete will gradually decrease when fine aggregate are replaced beyond 15% with Electronic waste.

Subramani *et al.* (2015) analysed the strength characteristics of concrete containing recycled waste plastic. It is identified that plastic waste can be disposed by using them as construction materials. Since the plastic waste is not suitable to replace fine aggregate it is used to replace the coarse aggregate. The compressive strength and split tensile strength of

concrete containing plastic aggregate is retained more or less in comparison with controlled concrete specimens. However strength noticeably decreased when the plastic content was more than 20%. It has been concluded 20% of plastic waste aggregate can be incorporated as coarse aggregate replacement in concrete without any long term detrimental effects and with acceptable strength development properties.

2. MATERIALS & METHOD

In imperative to study the influence of flex (waste plastic i.e. PVC) is added by weight of cement in concrete, 32 cubes for a mix have been cast in the laboratory. Cubes (150mm×150mm×150mm) were cast using a design mix of (1:1.58:3.38, where 3.38 is the proportion of 10mm 20mm aggregate), an effort has been made here to get the strength of cubes made up with different percentage of flex to the respective strength of conventional concrete at the end of 7and 28 days of moist curing and to have an idea about the optimum percentage of flex which does not affect the strength of non-conventional concrete considerably.

3. MATERIALS

3.1 Cement

In this work, Pozzolana Portland Cement (P.P.C) of Kohinoor brand obtained from single batches throughout the investigation was used. The Portland cement content mainly two basic ingredient namely argillaceous and calcareous. The physical properties of PPC as determined are given in Table 1. The cement satisfies the requirement of IS: 1489:19.

3.1.1 Fine Aggregate

The fine aggregate was locally available river sand which was passed through 4.75 mm sieve. The specific gravity of fine aggregate was 2.78 and fineness modulus of fine aggregate was 2.84.

3.1.2 Coarse Aggregate

The coarse aggregate was locally available quarry having two different sizes, one fraction is passing through 20 mm sieve and another fraction passing through 10 mm sieve. The specific gravity of coarse aggregate is 2.6 for both fractions. The fineness modulus of coarse aggregate is 7.33 . Proportion of 20 mm and 10 mm size aggregate was taken as 65% and 35%.

3.1.3 Flex (Waste Platic I.E. PVC)

In the present work the waste Flex is obtained from the advertising company. The physical properties of flex along with PPC (Pozzolana Portland Cement) are given in Table 2.

Table 1. Properties of Cement

S. No.	Properties of cement	Experimental	Requirement of code (IS 1489 (Pt-1)-1991)
1	Normal Consistency %	34%	
2	Initial setting time	35min	(Not fewer than 30 min)
3	Final setting time	215min	(Not greater than 600 min)
4	Soundness of Cement (Le chatelier expansion)	0.75mm	(Not greater than 10 mm)
5	Fineness of Cement (% reserved on IS sieve of 90 micron)	3.2%	10%
6	Specific gravity of Cement	3.1	3.15
7	Compressive Strength		
8	After 3 Days	23.0	16.0 N/mm^2(minimum)
9	After7 Days	33.0	22 N/mm^2(minimum)
10	After 28 Days	43.2	33 N/mm^2

Table 2. Physical and Chemical Properties of Flex along with PPC

Physical Properties	PPC Flex
Specific gravity	2.67
Mean grain size (µm)	21.5
Specific area (cm2/gm)	3770
Colour	Grey

3.2 Water

Potable water is used for mixing and curing. The water cement ratio (w/c) of 0.45 has been used.

3.3 Concrete

The concrete mix design was done in accordance with IS 10262 (1982). The cement content used in the mix design was taken as 380 kg/m^3 which satisfied minimum requirement of 300 kg/m3 in order to avoid the balling affect. Good stone aggregate and Natural River sand of Zone-II were used as coarse and fine aggregate respectively. Maximum size of coarse aggregate was 20 mm. A sieve analysis conforming to IS 383-1970 was carried out for both the fine and coarse aggregates.

3.4 Methods used for specimen preparation

3.4.1 Mix Design

M 25 grade of the concrete was used in the investigation and fine aggregate was kept as 50% of the total volume of aggregate. The resulting mix proportion of cement: fine aggregate: coarse summative was taken as 1:2.58:3.38(Where 3.38 is the proportion of 10 mm and 20 mm size aggregate) with water cement ratio is 0.45 and the quantity of cement is 380 kg/m^3.

3.4.2 De-Moulding

It required more investment to de-mold, clean and re-apply discharge specialist that it does to fill the mold. Solid items ought not be permitted to dry out after de-shaping before reality put into cure. The mold was cleaned as quickly as time permits after de-shaping.

3.4.3 Releasing Agent

It was considered best to use as little release agent as possible. Only a thin film is necessary. Surplus discharge agent collecting in end of the mould will cause discoloration. Release agent was pragmatic by impregnated sponges or cloths.

3.4.4 Curing

Solid items with low water concrete proportion can quickly dry out it this happens before hydration is finished. The bond not ever achieves its complete quality and the solid properties are unfavorably influenced. To guarantee contend hydration. It was fundamental that items were kept soggy quickly after de-shaping and amid the curing time frame. A few techniques for accomplishing this are presently being used, incorporating capacity in moistness chamber or haze room, fixing in polythene sacks, or aggregate inundation in water. As the manual for down to earth curing administrations. Solid items will accomplish a significant extent of their definitive quality when the primary cure is yielded out for 7 and 28 days, in stickiness of bigger than 95% RH and with a least temperature of 200 ºC. An appropriate post-curing administration will permit the rest of the quality to be accomplished.

3.4.5 Testing of the specimens

Compressive strength of cubes have been determined as per IS 516-1959 at a loading rate of about 140 kg/cm^2/min (about 30 tones per minute) on 2000 tons AIMIL compression testing machine.

The following specimens were casted for testing

- The cubes size 150 mm for compressive strength.
- The details of cubes and their nomenclature are given in Table 3.

Table 3. Cubes, addition of flex by weight of cement

S. No.	Cube designation	Size (mm)	FLEX %age
1	Cube 1	150×150×150	0
2	Cube 2	150×150×150	.75
3	Cube 3	150×150×150	1
4	Cube 4	150×150×150	1.5

4. COMPRESSIVE STRENGTH OF FLEX MIXED CONCRETE

The compressive strength of referral concrete as well as flex concrete at 7 and 28 days are given in Table 4. It is evident from this table that the strength is

increase with the addition of flex. Strength is increase up to 1.5% of flex. The disparity of compressive strength with thealtered percentage of flex is shown in Fig 4.1 & 4.2. These figure indications that the compressive strength of concrete with& without as purpose of curing time. The compressive strength of PPC is 23.4 N/mm^2, 31.6 N/mm^2 and 36.6 N/mm^2 when water/cement ratio is 0.45 at 7 and 28 days respectively.

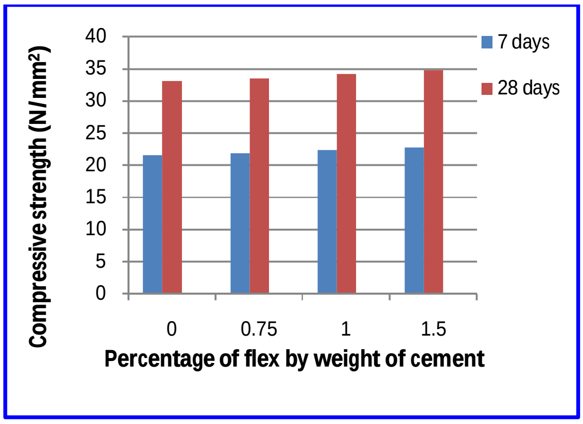

Fig. 4.1: Compressive Strength of Flex added Concrete (Column Chart)

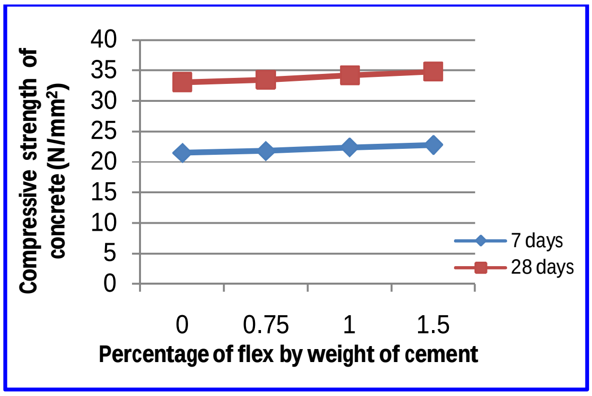

Fig. 4.2: Compressive Strength of Flex added Concrete (Line Chart)

Table 4.

S. No.	Cube designation	Compressive strength (N/mm^2)		% age of Flex
		7 days	28 days	
1	A1	21.5	33..1	0
2	A2	21.8	33.5	0.75
3	A3	22.4	34.2	1
4	A4		34.8	1.5

5. CONCLUSION

By the research work it was found that flex can be used in concrete. It is best way to dispose the flex, which is non-biodegradable and detrimental for the environment. There is no effect in compressive strength of concrete more over it increases with increase in the percentage of flex up to 1.5%. It also introduces the conception of green concrete. The concept of mixing of flex wastes in concrete could be a very environment friendly method of disposal of solid waste in the country, this study has shown a potential towards environment safety concept.

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